

## ***Interactive comment on “Optical depths of semi-transparent cirrus clouds over oceans from CALIPSO infrared radiometer and lidar measurements, and an evaluation of the lidar multiple scattering factor” by A. Garnier et al.***

### **Anonymous Referee #3**

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The authors present a new approach and they show a clear improvement on the CALIOP optical depth retrievals if a temperature-dependent multiple scattering factor is used instead of a constant value (which is currently the case for CALIOP Version 3 algorithm). It is clear that this is their main result. Nevertheless, the paper is not well-organized into the several sections. Provided that it is a long paper, I do not believe that keeps the reader interested throughout the text. Abstract is good content-wise but I would recommend not to start with the expression "This paper...". I would first write a statement addressing the general question that this paper tries to answer to. Then, the

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authors could write the methodology they implemented. In the conclusions part, there is repetition of what it was stated in the paper. I would recommend that they should try to summarize it better and make this part more compact and effective.

More specific comments:

- It is often confusing when the authors present equations. For instance, in page 2162, equation 9 comes very late. It should have been mentioned earlier because it contains the multiple scattering correction factor which the authors found to depend on temperature. This is a typical situation in the paper because of structure problems. Another issue with respect to equations is that they consist of variables which are not introduced to the reader. A characteristic example is equation (4) and (5). As far as I understand, the authors use the error propagation formula to retrieve the error  $d\tau\alpha$  in equation (4) but they refer to  $dR'x$ , which comes later in equation (5). I would propose that you write an expression of weighted radiance  $R'x$  as a function of equivalent brightness temperature  $T_x$ .
- It happens often that authors refer to their findings shown in a figure and later on, they refer to a previous figure. This looks confusing. An illustrative example is found in page 2160, line 2: the authors refer to simulation results in Figure 2 while in the paragraph above, they refer to Figures 5 and 6. Later in this section, in page 2161, line 8, the authors again refer to Figure 2 while in the previous paragraph, they were commenting on Figure 7.
- Usually, references are sufficient for the reader to follow the paper. Nevertheless, at some points, references are missing. In particular, reference is missing in page 2145, lines 21-25 where they refer to the "constrained retrieval". In addition, reference is missing in page 2150, lines 27-29 when the authors refer to a random error  $dTBG$ .
- I believe that the authors should give clear definitions for certain quantities (e.g., different temperatures) that they deal with in the paper at an early section. For instance, they present  $T_r$  and  $T(i)$  in section 3-"Cloud radiative temperature" which I think is a bit late.
- The authors should be aware that not all the readers are familiar with standard products of CALIOP and be more descriptive when they refer to certain products (e.g., page 2156, line 5).
- The authors should avoid beginning a

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sentence with a variable. For example, in section 4.1, paragraph begins with  $\tau_{vis}/\tau_{\alpha}$  which does not look like a nice way to start a statement. - There are few problems when authors present values. Page 2154, line 1: Better to write  $2 \pm 0.4$  than  $2 \pm 20\%$ . - There is quite a redundancy in the paper. Examples: (1) Page 2150, line 1-2: "Each term in Eq. 4 ... computation of  $\tau a$ " this goes without saying from the dependence of  $\tau a$  on quantities  $R'x$ . (2) Page 2166, line 1-2: Of course  $Scal, \hat{I}d'$  is null, when optical depths are approximately zero. I would recommend that authors remove the word null, which refers to null space of a matrix and not to a matrix with zero elements, if this is what they mean. - There is a small problem in the punctuation of symbols. In Page 2150,  $dR'x$  is with apostrophe in the text and with prime in the equations. I would try to keep it everywhere consistent. - There are some confusing long sentences which are difficult to understand. Page 2164, line 17-20: This sentence is long and not of a clear meaning. What is the complex journey of the photons? As far as I know, there is not such a valid expression. Do the authors refer to 2-way transmission within and below the layer or they refer to coherent scattering?

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